THE DOW CHEMICAL COMPANY

ROCKY FLATS DIVISION
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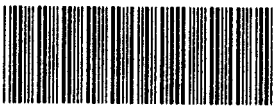

J. F. Willging

POSSIBLE "AREAS OF CONCERN"
RESEARCH AT ROCKY FLATS - Revised 10/6/69

Neighboring "concerned scientists" have questioned many Rocky Flats operating practices and limits related to our effect on our environment.

This report contains considerations of requests or desires of the concerned scientists and also of other possible items which should be investigated more. Items are discussed under headings:

Airborne activity

Waterborne activity

Solids - Waste Disposal

People

Effect of decreasing Rocky Flats Contamination limits tenfold

Recent or pending improvements in our approach to these environment problems and desirable additional research areas are noted.

Airborne Activity

Rocky Flats must be extremely careful to contain its contamination within the Rocky Flats site. In time there could be population just outside our outer fence. Contamination of a major population center with anything approaching present allowable limits would be considered a major national disaster. Major or perhaps not so major contamination outside the plant site could force the removal of Rocky Flats operations to some distant, sparsely-populated area.

Key Words
Proposals
Programs - Air
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Major contamination outside of Rocky Flats buildings would be considered an omen of loss of control and may allow later migration of activity outside the plant site.

Several subjects merit consideration.

1. A further major fire should be absolutely prevented. All possible means to prevent and limit a fire and resultant spread of contamination should be pursued. This is underway.

2. The possible escape of contamination from buildings should be controlled by a sufficient number of sprinkled absolute filters. This is underway.

3. Plutonium particles below about one micron in size which disperse more widely than the usual should be investigated with a program at Rocky Flats if necessary. Chemistry R&D is looking into generation and filtration of fine particle plutonium oxides. The measurement of these particles poses extra problems. R. A. Kirchner, Health Physics, has published in this field. Health Physics is starting a study on whether a problem exists and if so what to do.

4. Contaminated dust from the field where contaminated waste was stored has apparently been picked up by nearby on-site air monitors. Further contamination from contaminated storage drums may be largely eliminated by the use of cargo containers for contaminated drum storage on site. This area and any area outside building with measurable plutonium activity should be watched very closely. It probably warrants further action. See also section on waterborne contamination.

5. All stack effluents are being carefully monitored. They are our primary means of auditing site and offsite new contamination and of measuring the results of our filtration systems. Lowered stack

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effluent may be forced by circumstances. A decrease of this specification by a factor of 10 in amount of activity is thought in some quarters (C. Lagerquist) to be possible without a change of filtration equipment. An additional stage of filtration may be necessary in some cases. Rocky Flats routine air effluents concentrations are now 2 to 3 orders of magnitude below allowable offsite standards.

It might be mentioned that we measure the total radioactivity in the effluent air from Rocky Flats buildings as less than that in the inlet Colorado atmosphere. The biological effectiveness of the ~~Pu in the~~ effluent air is of the order of the biological effectiveness of the radioactivity in Colorado air.

6. Site and offsite monitoring stations measure the final result at their locations. The concerned scientists attacked the locations and the number of locations. One might assess the need for expansion by using consulting, AEC, or Weather Bureau meteorologists. The 1951 meteorological report on the Rocky Flats site was written by a Weather Bureau man. Chemistry R&D is attacking this problem.

Waterborne Activity

1. Waterborne contaminants from the Waste Treatment Plant and Sewage Plant of Rocky Flats have been under good control. Radioactivity offsite in these effluents is held at less than 10% of specification and of the order of the radioactivity entering our Water Treatment Plant. These effluents are backed up by holding ponds and diluted further by runoff. The effluents enter very sensitive areas, municipal and home water supplies and agriculture, so even more certain control may be justified.

2. Our story is not so virtuous for other waterborne activity. Any plutonium outside buildings can get into the ground, ground water, or runoff water. Activity has been measured

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in the ditch carrying runoff from the contaminated-drum storage. This presumably mostly fixes on dirt and settles to the bottom of the ditch, but should be followed closely and some action taken. The ditch activity did not extend offsite.

3. Activity has entered the soil of our contaminated drum storage. It has been detected one feet underground there. Plutonium normally travels very slowly in soils. Hanford cribs, into which millions of gallons of waste have been disposed, show plutonium movement of about 200 ft.

4. Plutonium in the ground would be expected to leach very slowly with the water in the soil. Ground water at Rocky Flats presumably leaches downward through the soil to rock one to 16 feet below the surface. It then runs above the rock in general eastward to near the edge of our mesa. It might outcrop here but probably follows ground water or may outcrop in a spring, ditch, lake, or beyond. Data on leaching rate would enable calculations of time of later difficulties. Plutonium, half life 24,000 years, stays with us for geological times, so we have to be careful with quick fixes or at least back them up with long term solutions. The paving of the drum storage area is an excellent start.

5. A research program on leaching of plutonium through Rocky Flats soils should be instituted. Additions of various Rocky Flats chemicals and other materials that might expedite leaching, such as chelating agents, and conditions which might fix plutonium relatively permanently should be tried. Hal Miller, a geologist in Chemistry R&D is looking into this.

6. Evaporation ponds, containing very low activity, are suspect from leakage and wind-borne spray but do dispose of a lot of water by evaporation. Shallow test wells to 30 feet show some nitrate but none is detected yet at 100-ft. depth.

7. Pu does not concentrate in the food chain. Some measurements on oxides showed only 10^{-6}% absorption in the gut.

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Presumably DTPA (diethylene trianine pentoacetic acid) chelated Pu would be about 3% absorbed in the gut as DTPA is. LASL is running tests as a result of the Spanish bomb incident.

Solid Waste Disposal

1. Continued efforts should be made to minimize the amount of Pu being discarded in the waste. Waste limits are being reassessed.

2. On-site waste storage and shipping methods are improving rapidly with cargo containers and special RR cars. The safet we can ship, the less our trouble after an accident.

3. About fifty kg Pu/yr. is shipped to Arco, Idaho in several hundred truckloads or cars of waste. Plutonium which cost about $50 million is now buried at Arco. The waste, in drums or boxes, is bulldozed into pits and covered. It is in volcanic soil several hundred feet above water level in an area with only 5 in./yr. rainfall. However, we have seen pictures of our barrels floating in water in the pits. The water several hundred feet below the surface ultimately joins the Snake River, much of which is used for irrigation. This does not seem an ideal solution, but is presumably not our problem.

4. This does emphasize that we should furnish our wastes in as insoluble a form as possible and minimize them. Chemistry R&D has drawn up an experimental program on encapsulation process improvement and plutonium container waste measurement involving 6 people. This seems a necessary part of our battle with waste.

5. We should be on the lookout for still better, more permanent disposal. Eastern Colorado does not seem optimum for plutonium burial. Perhaps a closed basin burial ground may be developed in Nevada or a Kansas salt mine used for burial. Hanford is investigating chambers excavated in rock.

People

We know of no one who has died from plutonium as a body contaminant or a source of plutonium radiation. Dogs are more sensitive than rats to plutonium so a program is being started on monkeys, (which are still closer to man) to define the Maximum Permissible Lung Burden (MPLB) better. It is doubtful that this work will change permissible burdens by a factor of 2.

The attached sheet (page 10) compares the effects of radiation and other factors upon human longevity. It does not seem that limits need to be changed much, keeping in mind that we are charged to operate as far as possible below limit.

Biomedical areas in which increased research should be undertaken seem to me to be:

1. Effect of particles of PuO_2 in a lymph node and methods of removal. Pu in the lung tends to move to the lymph nodes.

2. DTPA treatment optimization, for both short and long term Pu removal from the body.

3. Compounds, e.g., enzymes, hormones, to assist DTPA in removing plutonium from many places DTPA does not penetrate, e.g., lymph nodes or liver.

4. Chemical compounds improved over DTPA.

The above 1-4 could well be done in the Biomedical project requested by Rocky Flats and in the process of being turned down by AEC.

A further item on the Biomedical Project was clinical medicine, epidemiology and experimental work on improved processes for instance lung or lymph node treatment in connection with Pu containing employees at Rocky Flats.

Some of this might be done in RF Medical, perhaps as part of the Pu Registry work. This would require more medical space and personnel than at present.

One epidemiological study of merit is the occurrence of cancer and other diseases in Rocky Flats employees relative to the occurrence in other comparable people. These statistics may be slim now but will fill out as our employees age.

Health Physics Areas

Increased effort along their present lines, especially on development of more sensitive and versatile equipment, would seem very worthwhile. In particular, their plan to hire an at least M. S. industrial hygienist to look into "areas of concern" is excellent.

Effects of Decreasing Rocky Flats Contamination Limits Tenfold

The concerned scientists discuss possible effects from solid particle radiation, especially in the small volume of the lymph nodes, and the Sternglas effect of radiation on the human fetus.

If it should happen that the limits for human exposure to radiation and Maximum Allowable Body Burden were changed downward by a factor of 10, as they would like, the operational work of measuring and controlling radiation and the R&D at Rocky Flats would need to be increased markedly.

Measurement techniques would be hard put. For instance, the body counters can measure about one-sixth of a present lung burden. Assuming they could be improved several fold in sensitivity they would still have to count several times as long per person and measure many more people than at present.

Inhalation limits change might be taken care of with masks if each person carried a continuous monitor of airborne activity. This would probably lose less employees by quits than continuous mask usage. Remoting would be a positive answer for the operators.

Remoting would decrease the frequency of contaminated wounds. Gamma and neutron radiation limits could require several feet of shielding so remoting would be necessary here also. The cost of remoting most of our plutonium facilities is being studied and seems very high.

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In fact, the cost of remoting seems so high that one should investigate:

1. Still lower Pu-241 content.

2. Use of many more people part time in plutonium areas.

3. The use of older people who are less sensitive to radiation.

4. The accurate recording and evaluation of other aging or cancer causes, e.g., smoking, medical and dental X rays, etc., in our employees subject to plutonium with the hope of some control which could justify higher Pu limits than otherwise.

5. The cost of one R of radiation in man. Some mean cost of one R of radiation exposure of man might be worked out. This could be fed into computers with other types of plant costs to give an exposure limit with more economic validity. The dollar cost of an R will be difficult to obtain since the effect of an R varies much with age, with previous exposure, and with rate at which the R is accumulated. Also, the cost of early death during retirement is difficult to estimate.

Possible research and development projects in "areas of concern" are:

1. Small PuO_2 particle action in filters.

2. Monitor stations location and number.

3. Movement of PuO_2 in Rocky Flats ground water.

4. Improved waste encapsulation.

5. Decreased Pu to waste and waste volume.

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6. Improved drum counting.

7. Improved counting and measurement of almost all kinds.

8. Improved sampling and sample collection techniques.

9. Improved methods of plutonium removal from man.

Many of these have already been started by the concerned organizations.

I wish to thank M. A. Thompson, D. R. Cartwright, A. K. Williams, C. W. Piltingsrud, E. A. Putzier, their employees, and W. C. Bright for much help in this.

L. A. Matheson

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FORUM MEMO TO MEMBERS
Dec '65

Radiation and Life Expectancy

In the course of a talk at the "Safety and the Public" session of the Forum's annual conference, C. Rogers McCullough, vice president of Nuclear Utility Services, Inc., presented this table on the loss and gain of life span as a result of a number of factors, including radiation:

Loss of Average Life Span (minus) and Gain of Average Life Span (plus) as a Result of Various Factors

	Years
Non-Radiation Factors	
Country vs. city dwelling	+ 5.0
Married status vs. single, widowed or divorced persons	+ 5.0
Smoking — 1 pack cigarettes/day	— 7.0
2 packs cigarettes/day	—10.0
Overweight — 25%	— 3.6
Female vs. male sex	+ 3.0
Both father and mother lived to age 60	+ 3.7
Rheumatic heart disease — heart murmur	—11.0
— heart murmur plus strep infection	—13.0
Natural Background Radiation	
Calculated life shortening due to natural background radiation — 7 rem in 70 years	— 0.1
Man-Made Radiation	
Radiation worker, 30 years continuous exposure to maximum permissible dose (5 rem/year)	— 2.9
Individual — general population, 70 years continuous exposure to maximum permissible dose (0.5 rem/year)	— 0.7
Person in immediate vicinity of nuclear power station — estimate of actual condition	— 0.0007

Commenting, McCullough said:

"Note that all other factors listed give greater negative effects than those for radiation workers except being a man instead of a woman. No cases exist where either radiation workers or persons in the environment are exposed to anything like maximum permissible doses continuously. Actual exposures are small enough to give calculated life shortening of a small fraction of a day. Obviously, any such quantity as one thousandth of a year is the result of an exercise in arithmetic with no real meaning. The effects of other factors are only crudely known. Comparisons are valid only in the range of more than several years."

sion and upon the use of nuclear power by industry."

The next three speakers all made the point that the atomic energy industry is safe, that it is relatively safer than any other industry and indeed safer than most other human activities, and that the problem is to tell the public about it.

C. Rogers McCullough, vice president for development, Nuclear Utility Services, Inc., attempted to put the picture into perspective by presenting statistics on loss of life span from radiation and other phenomena (see accompanying table). He also pointed out that the accidental death rate from all causes in AEC installations was about half that in all other industries and that from radiation the rate was insignificant.

"In summary," he said, "the effects of radiation are well understood, better than the effects of many materials. There is a considerable and increasing history of successful and phenomenally safe operation of nuclear installations. The amounts of radiation to which workers and the public may be exposed will result in effects which can be expected to be much less than those from ordinary hazards of life, including the rapidly growing air pollution. There have been no disasters in the nuclear industry and in my opinion disasters are most unlikely. I can almost say impossible."

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